A Report on

Green House Gas Emission from SNDT Arts and Commerce College for Women, Karve Road, Pune

(Academic Year: 2017-2018)

Report Prepared by

Dr. Sunil D Kulkarni,

Shikshana Prasaraka Mandali's,

Sir Parashurambhau College,

Tilak Road, Pune

Email: sunil.kulkarni@spcollegepune.ac.in

Shikshana Prasarak Mandali's
SIR PARASHURAMBHAU COLLEGE
Tilak Road, Pune – 411 030.

NAAC accredited 'A+' Grade
Affiliated to Savitribai Phule Pune University
(ID No. PU/PN/ASC/003/1916)
☎ : Office : 020–24331978
☎ : Prin. Res. : 020–24332479
Fax No. : 020–24332479
http://www.spcollegepune.ac.in
E-mail principalspcollege@vsnl.net

Dr. Dilip Sheth
Principal

Ref No. : 553/2019-20
Date : 30.8.19

Certificate

This is to certify that, SNDT College of Arts and Commerce for Women, Vidya Vihar, Karve Road, Pune has carried out Carbon Footprinting of their Campus for the Academic Year 2017-2018. It is observed that the total emission of GHG of the said institute stands at **135705** kg of CO_2e (135.7 tCO_2e) for the concerned academic year and the per capita emission of GHG of from the campus is 101.45 kg CO_2e for this year. The detailed analysis of the GHG emission is presented in this Report.

Dr. Sunil D. Kulkarni
Department of Chemistry

SIR PARASHURAMBHAU COLLEGE PUNE

Dr. D. N. Sheth
Principal
Principal
Sir Parashurambhau College,
Pune - 30.

Date: Wednesday, August 28, 2019
Place: Sir Parashurambhau College,
Tilak Road, Pune

A Report on

Green House Gas Emission from SNDT Arts and Commerce College for Women, Karve Road, Pune

(Academic Year: 2017-2018)

Report Prepared by

Dr. Sunil D Kulkarni,

Shikshana Prasaraka Mandali's,

Sir Parashurambhau College,

Tilak Road, Pune

Email: sunil.kulkarni@spcollegepune.ac.in

Table of CONTENT

1. Abbreviations

1. SNDT College: SNDT Arts and Commerce College, Karve Road, Pune
2. GHG: Green House Gases
3. CFP: Carbon Foot Printing
4. CO_2e: Carbon dioxide equivalents
5. kg CO_2e: Kilograms of Carbon dioxide equivalents
6. tCO_2e: tons of Carbon dioxide equivalents
7. NAAC: National Assessment and Accreditation Council
8. SPPU: Savitribai Phule Pune University, Pune
9. UGC: University Grants Commission
10. DST: Department of Science and Technology, Government of India
11. DBT: Department of Biotechnology, Government of India
12. BOD: Board of Directors, SPPU, Pune.
13. ppm: Parts per million
14. IPCC: Intergovernmental panel on Climate Change
15. DTC: Data Collection Tool
16. SDK: Dr. Sunil D Kulkarni, Sir Parashurambhau College, Pune
17. LPG: Liquefied Petroleum gas

2. List of Figures:

List of Tables:

3. Summary

SNDT Arts and Commerce College, Karve Road, Pune took an initiative to quantify their green house gas (GHG) emission patterns (carbon foot prints) from their educational campus for the academic year starting from June 2017 to May 2018. This report has been prepared been prepared by Dr. Sunil D. Kulkarni, Assistant Professor in Chemistry on the behalf of Sir Parashurambhau College by adhering to the ISO 14067, 2012 and IPCC standard. The GHG quantification is done in terms of carbon foot prints (CFP). The carbon foot prints are expressed as Carbon dioxide equivalents (CO_2e) in relevant multiples.

The College has fifteen departments/areas that contribute to GHG emission directly or indirectly. The total emission of GHG of modern college stands at **135705 kg of CO_2e (135.7 tCO_2e)** for the concerned academic year. It was observed that the per capita emission of GHG of from the campus is **101.5** kg CO_2e for this year. As SNDT College is multi-faculty college, intra faculty comparison is obvious. The details are discussed in the present report.

In India, there is no specific threshold specified by the government or any other agency for maximum emission of GHG by an educational institute but most of the western countries and USA consider 25 kilotones of CO_2e per year as the maximum permissible threshold for one campus academic institutes. So it can be concluded that GHG emission of Modern College campus is less when compared with international thresholds.

4. Introduction

A brief introduction to SNDT Arts and Commerce College, Pune

The SNDT Women's University was established by Bharatratna Maharshi Dhondo Keshav Karve in 1916 and was generously supported by Sir Vitthaldas Thackersey. It is the first of its kind in India, imparting education exclusively to women, to suit their aspirations in the fast changing world. It got a statutory recognition in 1951 and thus became at par with any other University in India. It has been striving for the upliftment, betterment and empowerment of women from all social strata throughout Maharashtra and Gujarat, through comprehensive and all round progress in education. In 2000, The NAAC established by the UGC has accredited SNDT Women's University and also the College. This is the first University getting a high ranking in accreditation in Maharashtra and the second University in India, voluntarily applying for such a kind of evaluation through NAAC and passing the golden test with flying colours.

SNDT Arts and Commerce College for Woman is a flagship institute of SNDT Women's University. It is the oldest and the premier college of this University, carrying the touch of glory and heritage of this renowned University. Situated at Maharshi Karve Vidya Vihar, the most beautiful and specious campus of the SNDT University on Karve Road, Pune, this college has been offering various courses in Arts and Commerce, right from Junior College (XI and XII) to undergraduate and post-graduate degree. The college has been a center of attraction not only for the students from all over India but from abroad as well. Renowned faculty, personal attention to the students, up to date and challenging syllabus, various co-curricular and extra-curricular activities, hostel facilities, well equipped library, sports facilities are some of the special features of this college.

Our Motto

“Sanskrita Stree Parashakti”, meaning ‘An enlightened woman is a source of infinite strength’, aptly encapsulates the vision of Maharshi Karve to build a citadel of learning for women. The College, for over nine decades, has been striving hard to translate this motto into reality.

The Vision of the College

Being a conducted college of the SNDT Women's University, the College pursues the vision of the University in Toto. The Vision of the University is: "Today we visualize the SNDT Women's University as a world class university that continually responds to the changing social realities through the development and application of knowledge. The purpose of such engagement will be to create an inclusive society that promotes and protects the dignity, equality, social justice, and human rights for all, with special emphasis on empowerment of women."

The Mission of the College

In the light of this vision, the University has envisaged the mission to be: "SNDT Women's University is committed to the cause of women's empowerment through access to education, particularly, higher education, through relevant courses in the formal and non-formal streams. Further the university is committed to provide a wide range of professional and vocational courses for women to meet the changing socio-economic needs, with human values and purposeful social responsibility and to achieve excellence with "Quality in every Activity".

The goals of the Institute emerging from the Vision and Mission are-

• Provide multidisciplinary academic and vocational courses for students to meet the socio-economic demands;

• Engage students in research activities in emerging areas of study with focus on women's perspectives.

• Inculcate among students positive self-concept, awareness of women's issues and rights with a rational

outlook towards society;

• Impart meaningful education with social relevance and orientation; and

• Achieve excellence in the academic and extension activities through emphasis on 'quality in every activity'.

Origin of the Present Project

There is a wide acceptance that increasing emissions of greenhouse gases (GHGs), results in global warming. Measurements taken in 2005 indicate that emissions of dominant GHGs have reached 379 ppm; comparable to the pre-industrial value of 280 ppm (IPCC, 2011). GHG emissions due to the industrialization and development of modern society, are responsible for pronounced effect on the make-up of the life supporting systems of the Earth. Thus, it is necessary to identify sources of emissions for their sequestration/mitigation. One of the best methods to assess the GHG emission is by quantifying the carbon foot prints.

A carbon footprint can broadly be defined as a measure of the greenhouse gas (GHG) emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product or service, expressed in carbon dioxide equivalents (Wiedmann and Minx 2007). According to IPCC, there are a total of 18 greenhouse gases with different global warming potentials, but under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto protocol, only few gases are considered for the purposes of carbon accounting. The gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur dioxide (SO_2).

There are two main approaches to calculating carbon footprints: top-down and bottom-up methods. While the former is based on input-output data and generally useful for sector level or country level analyses, the latter is based on life-cycle analysis that accounts for emissions of individual items from cradle to grave. For large entities and institutions, it is usually necessary to integrate the two methods for a more comprehensive carbon accounting analysis. In the present project bottom up approach is used for determination of CFPs of SNDT College.

Need of the Current Project

With the availability of funding, resources, manpower, and the conducive environment for teaching-learning process and research; educational institutes consume a lot of resources that lead to emission of GHGs directly or indirectly with potential of

global warming. Measuring the quantity of GHG emission is now regarded as an important step for improving the optimum use of resources and also helps in identifying the source of emission.

At the same time, it should be noted that, per capita emission of carbon or consumption of energy is also an important criterion for development. So any institute must have a proper balance of GHG emission and carbon neutrality. Such an estimation of GHG emission is then useful in optimizing the use of resources and their exploitation with maximum efficiency. Estimation of GHG emission may also plays an important role in cost management and savings in terms of money and may help better asset management. It is also helpful in prohibiting/avoiding the misuse of available resources.

As far as higher educational institutes in India are concerned, their apex accreditation body, NAAC has clearly asked in their criterion VII that if the institute has performed green audit of the campus. This indicates that the government and the policy makers are taking measures for green educational hubs which are sustainable and eco-friendly. The present project is a major step towards a comprehensive 'Green Audit' of the campus.

Scope of the Project

The carbon foot prints of SNDT College, Pune are to be determined for the academic year starting from June 2017 to May 2018. This year may be considered as a base year for further calculations. The emission sources were identified by detailed survey of the campus. The major emission sources are identified as fuel, water, electricity, paper, travel by students and faculty for academic purpose and their transport. The emission factors for calculations were taken from either IPCC or generated as per the requirement of local conditions. At the end of the report specific recommendations are made for possible measures that the institute may undertake for carbon neutrality of the campus.

5. Methodology

A general methodology adopted for achieving the said purpose is shown in the Figure 1.

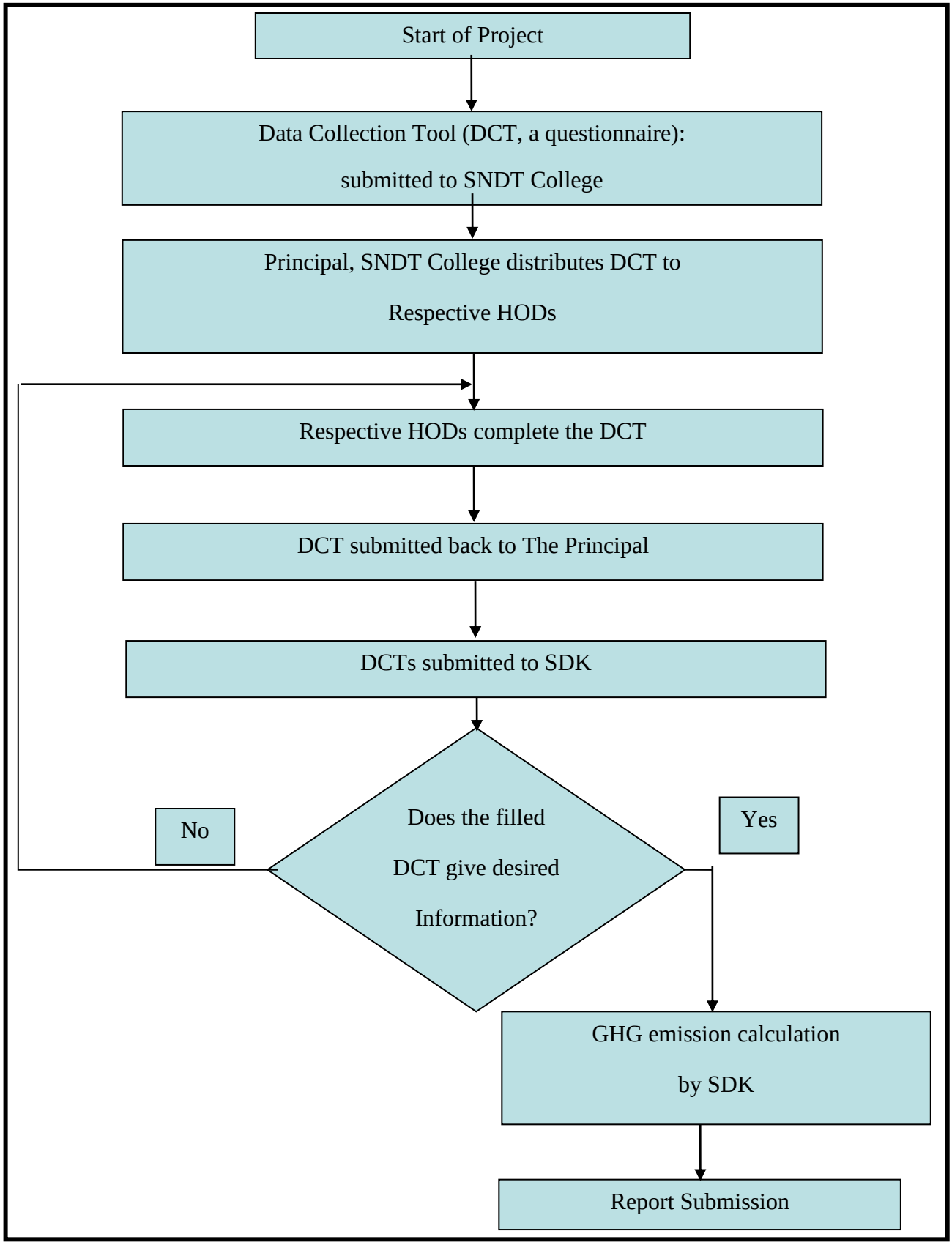


Figure 1: Steps involved during the course of the project

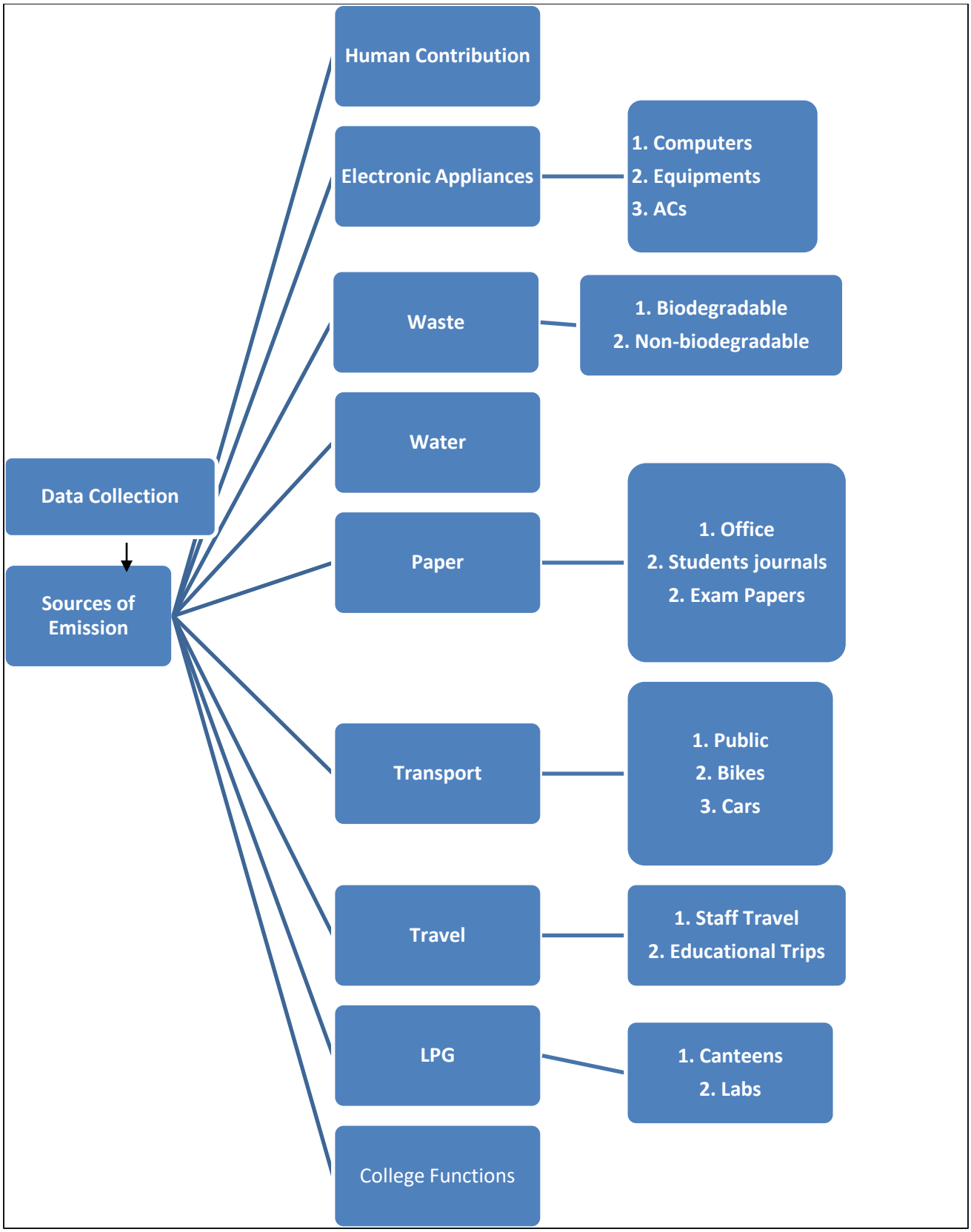


Figure 2: Sources of Emission of GHGs identified by using DCT/Campus survey

Classification of sources of emission

After careful survey of the campus and from the information provided in the DCT, the sources of GHG emission were identified. It was observed that, electronic appliances, (such as computers, air conditioners, deep freezers), biodegradable and non-biodegradable waste, water, paper (including stationary), cooking gas (LPG), travel by staff and students, various functions (such as conferences, symposia and workshops) organized by the college, electricity along with human breathing factors contribute significantly to total emission. As a first step, the identified emission sources were classified as SCOPE-1, SCOPE-2 and SCOPE-3 as per the guidelines of IPCC.

SCOPE-1

Scope-1 emission sources are those contributors that add GHGs directly to the atmosphere. The emissions from burning of fossil fuels such as from heating of water or use of LPG cylinders in the laboratories, canteens and hostels, consumption of fuel for transport and travel. It also includes fugitive emissions such as refrigerant leakages, fire etc.

SCOPE-2

These are direct emissions due to the use of electricity purchased from a common grid or from power stations for use of electrical appliances, lighting within the building and street lighting within the campus or any other use of electricity.

SCOPE-3

These are the indirect emissions resulted from the consumption of other resources such as water, paper, food, consumables, waste generated. Following table shows the sources of emissions from SNDT College according to scopes.

Table 1: Classification of sources of emission from SNDT College according to Scopes

Sr. No.	Scope	Source/Activity
1	SCOPE-1	(1) Use of LPG, (2) Transport of staff, (3) Human breathing
2	SCOPE-2	(1) Electricity
3	SCOPE-3	(1) Travel of staff and educational trips, (2) waste, (3) paper, (4) Ink, (5) Toners, (6) Events etc.

6. Analysis of the Data

Scope wise distribution

Analysis of data obtained through DTC showed that, scope 1 contributes 37%, scope 2 contributes 20% and scope 3 emission sources contribute almost 43% of the total emission of SNDT College.

It is known that Scope 1 consists of emission sources that add carbon dioxide directly in the atmosphere. In the present case the scope 1 sources identified are transport of the staff, use of LPG and human factors. These sources are so primary that a very little can be done to lower the extent of their emission. However car pooling among the staff coming from same area in the city to college, use of renewable energy powered heating appliances instead of LPG powered may significantly lead to lowering of Scope 1 emission.

Electricity purchased from the common grid or directly from power plant is emission source in Scope 2. In India, electricity comes from public sector companies through a common grid. Variety of fuels contribute to grid such as non-renewable like coal, naphtha, diesel, nuclear (Non-renewable fuel sources contribute 95% to total electricity being generated) and renewable like (whose contribution is low at 5% of total electricity) solar, wind, hydro-electricity etc. It should also be noted that 80% of total electric power generation stations run on coal which as it is known is one of the dirtiest source of electricity. In the present project, calculations are done assuming that 80% of the electricity is generated using non-renewable fuels like coal and naphtha whereas remaining 20% contribution comes from renewable sources including nuclear energy. Analysis of data from the college showed that, a significant 20% of GHG emission comes from electricity i.e. Scope 2.

Few recommendations can be made to reduce the scope 2 emission.

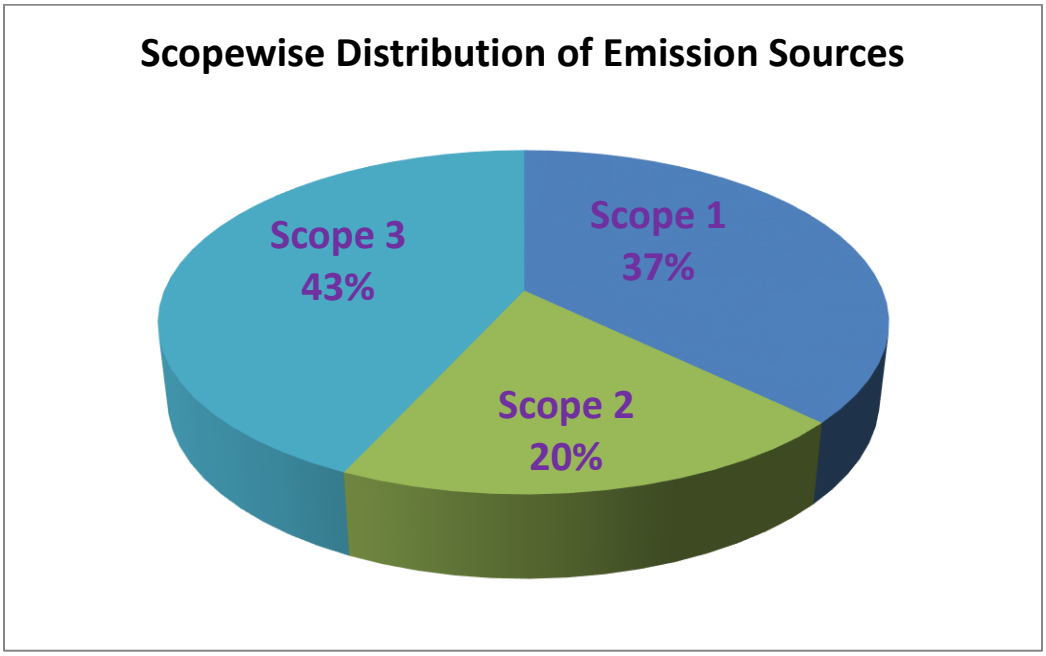
(1) Increase the use of renewable energy sources. (such as installing solar electricity power station)

(2) Proper and routine maintenance of electricity consuming equipments such as computers and peripherals, laboratory instruments and other electrical instruments.

(3) Switching of fans, electric bulbs when not in use and if possible transfer to low electricity consuming light sources such as LEDs and star rated electronic gadgets. An arrangement may be worked out such that every day, for one hour all the lights, fans and electronic appliances that are not absolutely essential are switched off.

Scope 3 emission sources add GHG indirectly to atmosphere through consumption of resources like paper, water and other activities organized by the college in addition to biodegradable and non-biodegradable waste. Data analysis for SNDT College showed that about 43% of emission of GHG comes from these indirect sources. Since these are the emission due to consumption of resources, the emission contribution can be significantly lower by considering some of the recommendations made in the preceding sections of this report.

Figure 3: Contribution to total GHG emission from emission sources classified as Scope 1, Scope 2 and Scope 3.



Source wise emission analysis

Emission source wise contribution to GHG emission of SNDT College is shown in the Figure 4. Although human factor contribute almost 19% of total emission, its effect will not be discussed here as it is understood that breathing by humans is a natural process and its contribution may be offset by green cover in the campus. Other notable GHG emission contributors are use of electronic appliances, transport and commutation of teaching and non-teaching staff, use of paper in addition to that of water and everyday waste generated.

Use of paper:

It is observed that almost 3 to 4% of total emission comes indirectly through use of paper and stationary. For any academic institute, use of paper is indispensable. Paper is required for administrative purpose, students' journals and manuals, examination booklets etc. So judicious consumption of paper should be done and its use should be monitored thoroughly since students and other stakeholders are not much aware about GHG emission due to use of paper. Use of glossy paper should be avoided as it has high grammage (GSM). Implementation of e-administration can decrease the consumption of paper drastically. Online academic content should be made available to the students. Online admission process, e-prospectus may also significantly decrease the use of paper.

Use of water:

Carbon foot prints of water are found to be negligible owing to its small equivalence parameter (0.002 kg/L) CO_2e. Water is required for drinking, in the laboratories as solvent, as a cleansing agent, for maintenance of gardens and building repair work. Restricted use of water may not have much effect on the net carbon foot prints but proper use of water is suggested. Recycling of sewage water, waste water treatment in the laboratory before being drained in the sink may lead to significant decrease in the CFP due to water.

Biodegradable and non-biodegradable waste:

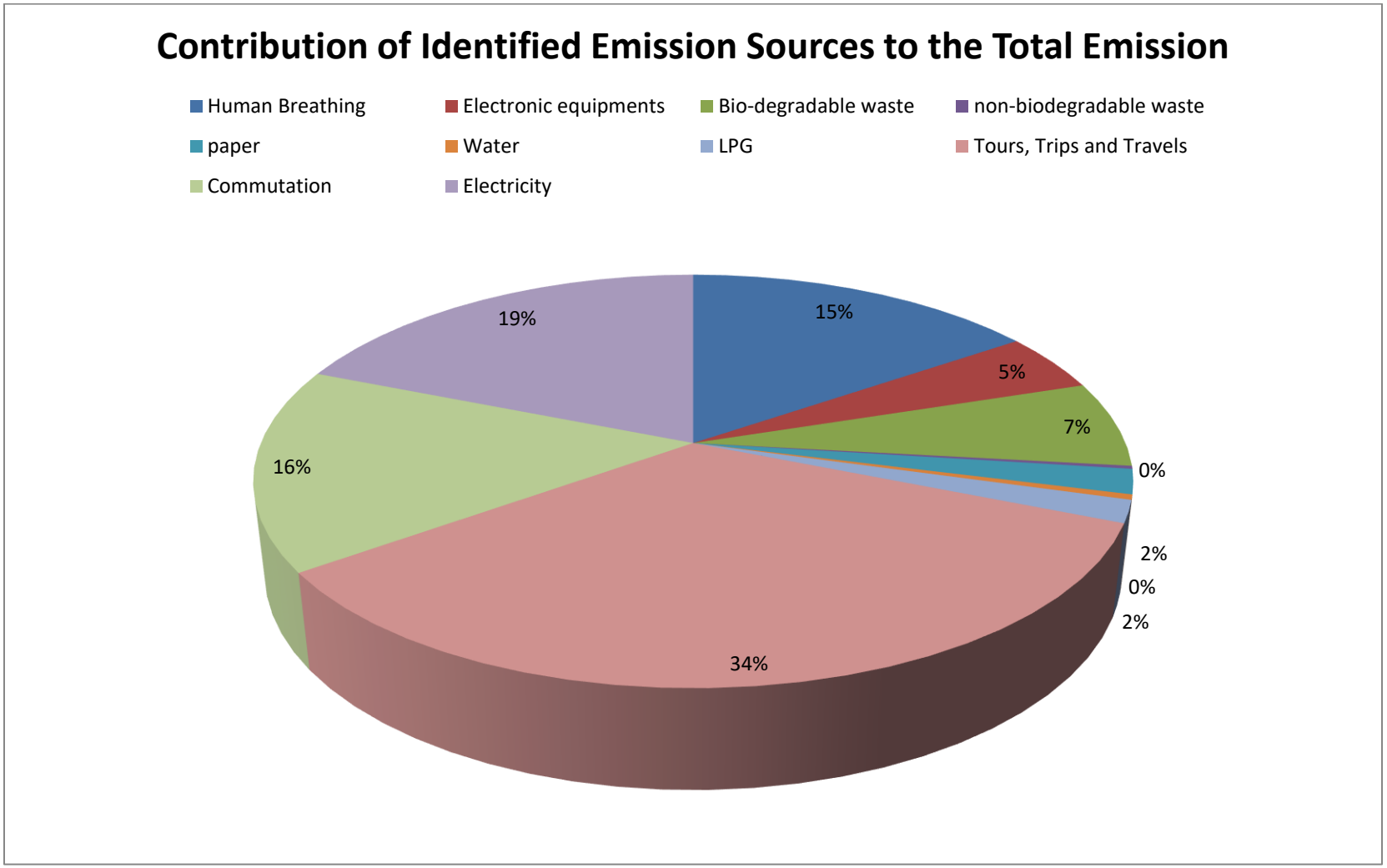
Data collected from SNDT college showed that the biodegradable waste generally comes from canteens and from establishment section responsible for maintaining gardens and surroundings and contributes to 7 to 8% of the total emission. Composting is one of the methods to recycle this to certain extent but it also leads to emission of harmful gases such methane to the atmosphere. Hence the conversion factor for this type of waste is one kilogram of this waste generates almost 1.5 kilograms of GHGs. So care should be taken to prevent the production of this type of waste at the source only. However since this type of waste can be degraded by microbes, it does not remain in the environment for long time.

Non-biodegradable waste generally is from waste glass, plastics, building materials including steel and cement and many such things in the laboratories. The conversion factor for this type of waste is just one kilogram of this generates 0.125 kg GHG as this type of waste can be recycled to 100% extent. But if this does not happen then conversion factor becomes 10 kg GHG /kg of waste. So it is a common responsibility of every stakeholder (Teachers, students, non-teaching staff, administrative staff and the college management) to ensure that this type of waste should be recycled. This also calls for one of the recommendations that the dry (generally non-biodegradable) and wet (generally biodegradable) waste should be separated with utmost care and disposed off as per the norms or recycled.

Educational tours and Academic Travels by the staff

Since Educational tours are the important part of curriculum, one cannot have much control on its GHG emission. However few suggestions/recommendations may be followed wherever possible. (1) Hiring of CNG/LNG/LPG i.e. gaseous fuel run buses instead of liquid fuel run vehicles. (2) Choosing a common location for a class because different locations for a class may result in high GHG emission.

Figure 4: Contribution of emission sources to total CFP of SNDT College

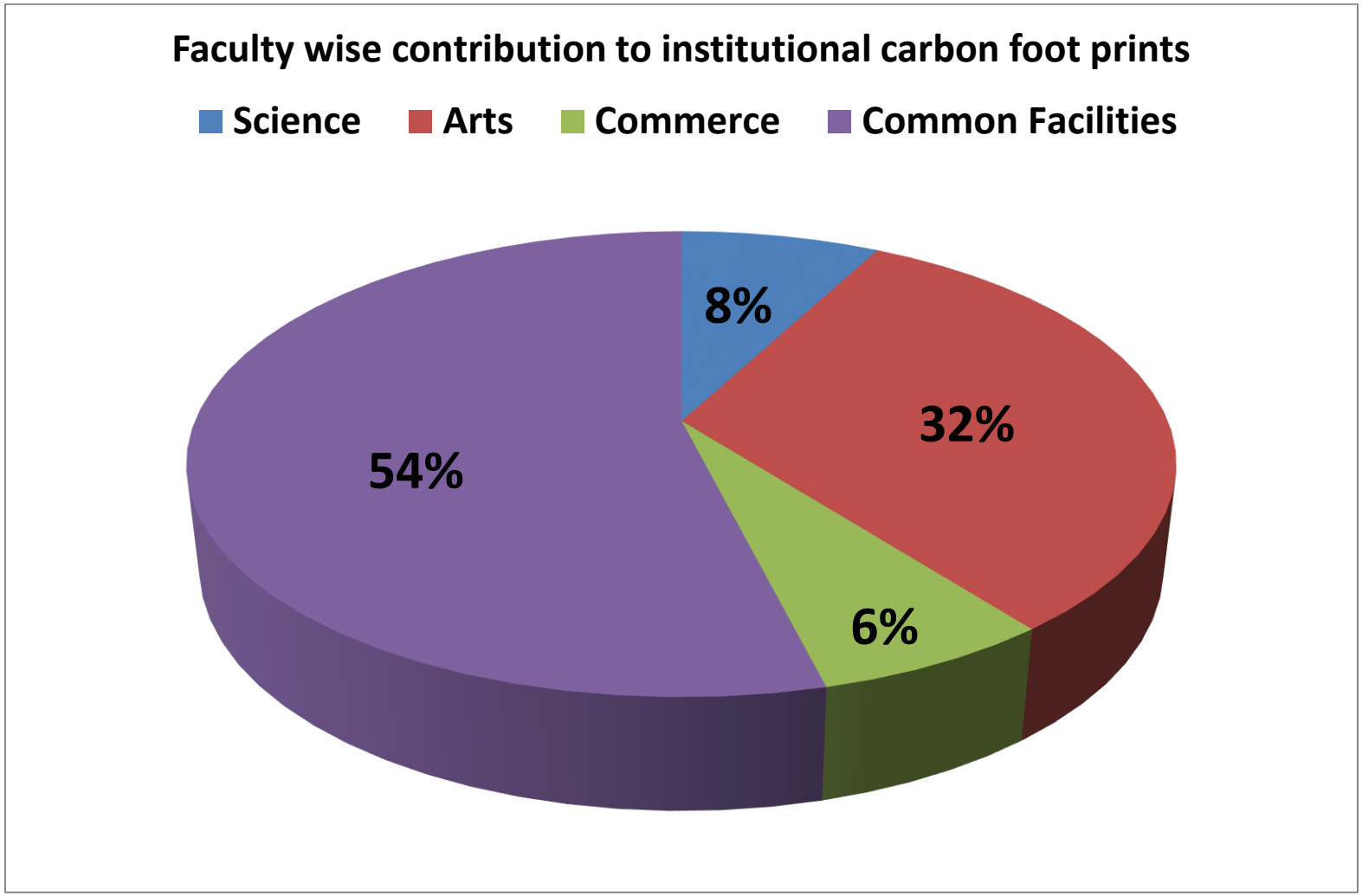


Faculty-wise contribution to GHG emission

This institute is a multi faculty co-educational institute. It comprises of Arts, Science and Commerce faculties. Running these faculties efficiently leads to consumption of substantial resources. There are also additional facilities required such as administrative offices, canteens, campus maintenance department and housekeeping facilities etc. In the present section we have analyzed the faculty wise GHG emission of the institute is analyzed.

It was observed that, GHG emission from computer science stands at **9384.3** kg CO_2e per year followed by Arts and humanities department at 38375.3 kgCO_2e per year. The GHG emission of Commerce faculty stands at **7981.9** kg CO_2e per year. It should be noted that, scope 2 emission i. e. contribution from purchased electricity is excluded from these values as college does not have department wise record of electricity consumption. Figure 4 shows the faculty wise GHG emission contribution. The significant amount of emission is also observed from the category, common facilities contribution is at 18% amounting to 65224.2 kg CO_2e. The others include EVS, Cyber crime, Human rights, Canteens, Administrative office, Campus, establishment and housekeeping, Physical Education, Sports, NCC and NSS and Library.

Figure 5: Green house gas emission by Modern College: faculty wise contribution



Computer Science Department:

Science faculty contributes to only 8-9% (**9384.3)** of the total emission from the college. The science faculty comprises of only one departments of computer science the department has well equipped laboratories that contribute significantly to emission. However use of good laboratory practice (GLP) norms may significantly reduce emission. The table shown below gives the total emission, per capita emission and the emission density of the faculty.

Commerce Faculty:

The commerce faculty GHG emission for the academic year stands at **7981.9** kg CO_2e which corresponds to only 6-7% of total emission from the college.

Faculty of Arts and Humanities:

Figure 7 shows the GHG emission pattern of various departments in the Arts and Humanities faculty. This faculty consists of Geography, Economics, English, Hindi, Marathi, Psychology, Visual Arts and Music departments. The total volume of GHG emission of Arts faculty is **38375.3** $kgCO_2e$ per year which is the highest of all the faculties. The important contributors are Geography, Psychology and English. It should also be noted that, the main source of GHG emission for the arts faculty is from use of paper for examination and students journals (as in the case of geography). Languages seem not to contribute too much of the GHG emission as they do not require much of paper, laboratories and other resources.

Table 2 shows per capita emission of GHG from the Arts faculty departments. The lower emission of GHG from Arts faculty is attributed to, as per the data provided by the departments, less consumption of electricity by electronic appliances, lower consumption of papers as there is no need of students' journals and manuals. It can be seen from the Table 2 that geography, economics, English and psychology are the major contributors. However major sources of carbon footprints are due to use of examination paper and related stationary owing to large number of student pool.

Figure 5: Faculty of Arts and Humanities: Emission pattern of the departments.

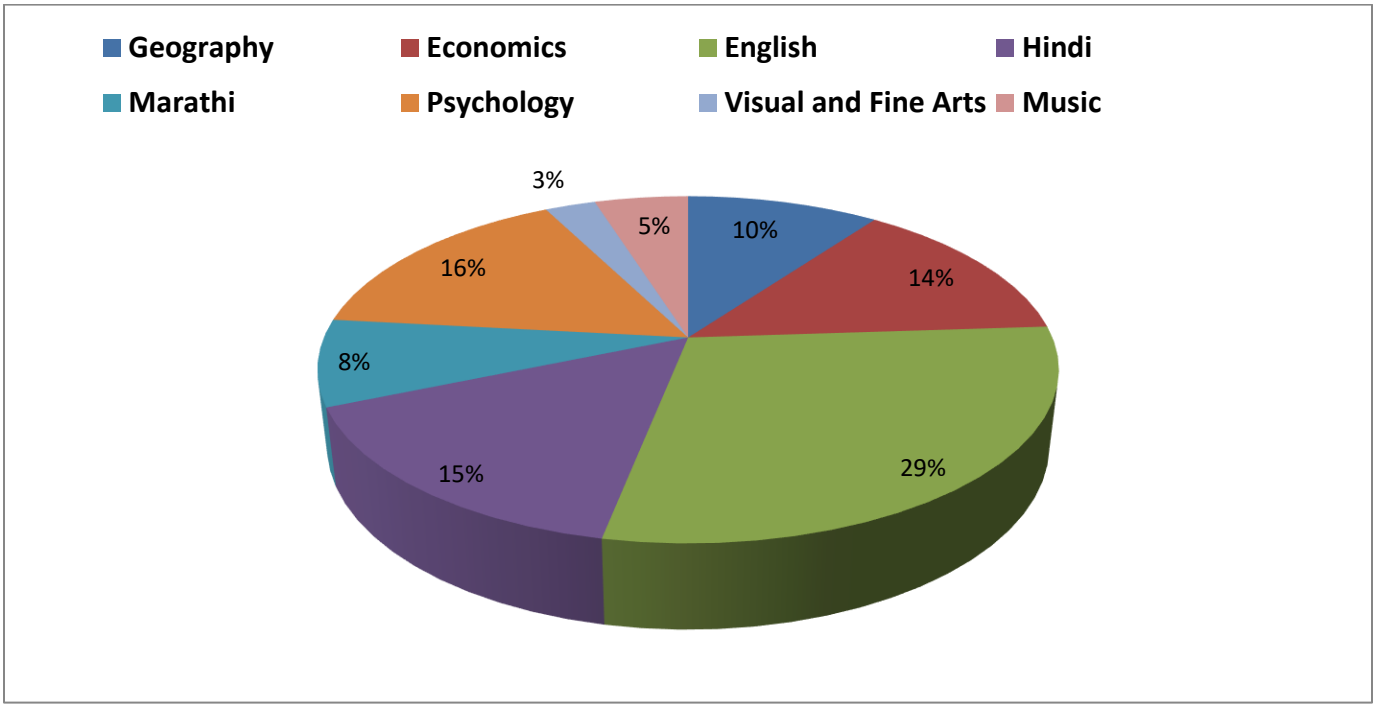


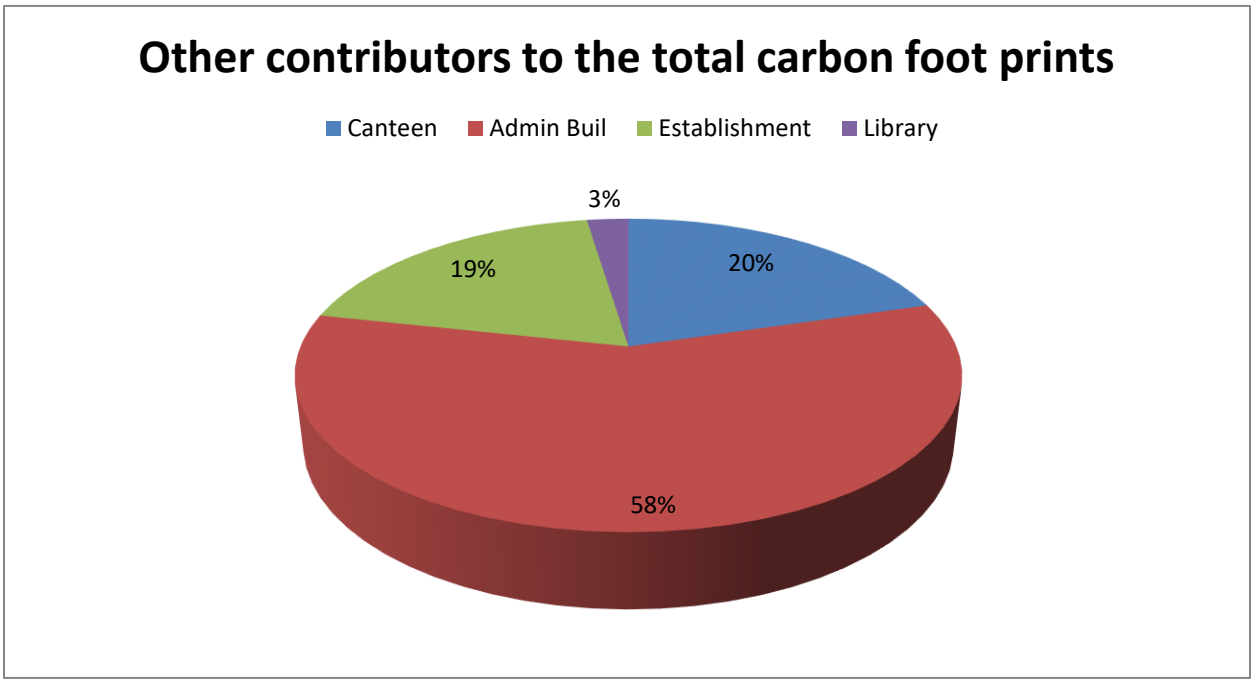
Table 3: Per capita and total emission of GHG from the Arts faculty departments

Sr. No.	Name of the Department	Total GHG emission (kg CO_2e)	Per Capita emission (kgCO_2e)
1	Geography	3845.7	13.6
2	Economics	5344.7	17.4
3	English	11189.0	33.9
4	Hindi	5968.4	3.3
5	Music	1875.0	6.9
6	Marathi	3093.2	1.1
7	Psychology	6047.3	14.1
8	Visual and Fine Arts	1012.1	12.5

Others

There are many other sections in the college, which cannot be classified as academic department but contribute significantly to GHG emission. These sections are (A) Canteens, (B) Administrative office, (C) Campus establishment and housekeeping, (D) Physical Education, Sports, NCC and NSS and (E) Library etc. The administrative office is responsible for almost 45% of the total emissions of 'others'. Figure 10 shows the emission patterns of these auxiliary sections of the college. Per capita emission for this category may not provide any important inference as these values are very small since most of these are common facilities used by almost all students, teaching and non-teaching staff members of the college.

Figure 9: Emission patterns of non-academic sections of the college.



7. Uncertainties and Sources of Error in the CFP Calculations in the Present Project

(1) Uncertainties on the data provided by the respective department

(2) Error in the final calculation due to non-provision of the data such as e.g.

   (a) Ultimate disposal of instruments and metallic waste

   (b) Details about the fuel used in generator

   (c) Exact distance travelled by staff for transport/tours

   (d) Exact number and type of paper used in the college

   (e) Details about the functions/conference/symposia held in the college during the academic year.

(3) Small error in the CFP calculations due to chemicals as there are no specific norms available even at the international level.

(4) Unavailability of the data on the visitors and various external sources

It agreed that all these possibilities may introduce and error of 5 to 10% in the final calculations.

8. PROJECT HIGHLIGHTS AT GLANCE

(1) Total CFPs of SNDT College 135705 kg CO_2e per year.

(2) CFPs of Computer Science are 9385 kg CO_2e per year and that of Commerce and Arts faculties are 7982 and 38376 kg CO_2e per year respectively.

(3) The CFPs due to consumption of electricity are 31443 kg CO_2e per year.

(4) CFPs due to other sections of college including the administrative office are 65224 kg CO_2e per year.

(5) Significant contributors to CFPs are the academic Departments of from Arts and Humanities faculty along with the Administrative office.

(6) Per capita carbon footprint of the college is 101.45 kgCO_2e

9. Recommendations and Suggestions:

Although many recommendations are suggested in the report, here few general

are enlisted.

1. Electricity: It is suggested that, some arrangement should be worked out so that a separate record of consumption of electricity by each department is documented.

2. Waste Disposal: It seems the institute has already marching towards zero garbage but more efficient methods have to be worked out for proper disposal of wet and dry waste.

3. Paper: This scope 3 emission source almost contributes 6-7% of the total emission. Its use should be done judiciously.

4. A system may be worked out for students parking so that CFP calculations are facilitated accurately and they may be advised to use public transport system.

5. Staff vehicle pooling will definitely reduce the CFP to large extent.

6. It should be noted that, biodegradable waste contributes significantly to GHG emission so installation of compost plant will generate revenue for the institute as well as cater for own need of fertilizer for green campus

9. Recommendations and Suggestions:

Although many recommendations are suggested in the report, here few general are enlisted.

1. Electricity: It is suggested that, some arrangement should be worked out so that a separate record of consumption of electricity by each department is documented.

2. Waste Disposal: It seems the institute has already marching towards zero garbage but more efficient methods have to be worked out for proper disposal of wet and dry waste.

3. Paper: This scope 3 emission source almost contributes 6-7% of the total emission. Its use should be done judiciously.

4. A system may be worked out for students parking so that CFP calculations are facilitated accurately and they may be advised to use public transport system.

5. Staff vehicle pooling will definitely reduce the CFP to large extent.

6. It should be noted that, biodegradable waste contributes significantly to GHG emission so installation of compost plant will generate revenue for the institute as well as cater for own need of fertilizer for green campus

30.8.19

PRINCIPAL
S.N.D.T. Arts & Commerce
College for Women, Pune-38

S.N.D.T. Arts & Commerce College for Women ★ Pune-38.